

BREAKING DETECTOR FOR SHEAR PIN

FIELD OF THE INVENTION

The invention relates in general to a breaking detector
5 for a shear pin.

BACKGROUND

In a wicket gate system of a hydroelectric turbine, the gates are oriented by means of a mechanism having articulated arms. The articulations of the arms are maintained by shear pins adapted to break when an abnormal effort is applied on a gate. Such a situation may happen if, for example, a gate jams a wood log or a rock during the closure. By breaking, the shear pin protects the gate and all the gating mechanism which is linked to it against more important breakage. Each shear pin acts so to speak as a mechanical fuse which protects the gating mechanism. It is necessary to detect as soon as possible the breaking of a shear pin and to identify the defective shear pin to re-establish the proper functioning of the gating system. For this purpose, it has been taught to insert a tearing or breaking detector in each shear pin.

The current detectors are normally made of a wire inserted in a bore at the center of a shear pin. The bore is filled with epoxy to hold the wire in place. Each detector is connected in series with the others up to a common alarm point usually supplied with less than 100 Vac.

When a shear pin breaks, the wire is cut and the loss of power supply triggers an alarm. The detectors being connected in series, it is not possible to readily determine which shear pin is defective.

By their situation, the wires connecting each detectors are sometimes snagged and disconnected. In order to limit

the reparations, each detector is preferably provided with quick connectors. If a cable breaks, only the broken part is changed. Mechanical protection systems are also added on each shear pin to protect the quick connectors against breakage by snag. Despite everything, certain mechanical breakages requiring replacement of the cables occur. Furthermore, the shear pins often bathes in water, oil and grease. In the long run, these conditions finally attack the cables and the connectors.

There is often groundings and the detection is difficult since the system is connected in series, in floating point. Since the wires are embedded in epoxy, it is then necessary to remove the shear pin completely, to clean it from the epoxy and re-install a new detector. Faced with the extent of work to be done, it becomes more simple to change the shear pin by a new one, which involves higher costs. In the case where the connections between the detectors run from the bottom of a shear pin to the top of another, it may be difficult to remove the portion of a broken cable hanging under a shear pin.

SUMMARY

An object of the present invention is to provide a breaking detector for a shear pin which facilitates the detection of a defective shear pin.

Another object of the present invention is to provide such a breaking detector which is easily replaced without necessarily having to change the shear pin if it is still in good condition.

Another object of the present invention is to provide such a detector which is more resistant to water, oil and grease than the current detectors.

Another object of the present invention is to provide such a detector which is easily adaptable to any kind of installation.

According to one aspect of the present invention, there is provided a breaking detector for a shear pin having a central bore, comprising:

an electrically conductive element forming an elongated loop extending on a length of the bore of the shear pin and having upper ends defining contact surfaces adjacent to each other;

an electrically insulating element extending in the loop;

supply cables connected respectively to the contact surfaces and provided with connectors; and

an electrically insulating means for removably supporting the elements of the detector in the bore of the shear pin.

Preferably, the detector will comprise an identification circuit having a light indicator connected between the contact surfaces, the light indicator projecting at an upper end of the means for supporting.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of preferred embodiments of the invention will be given hereinbelow with reference to the following drawings, in which like numbers refer to like elements:

Figure 1 is a schematic perspective view of a breaking detector.

Figure 2 is a schematic elevation view of a shear pin provided with a breaking detector.

Figure 3 is a schematic elevation view of printed circuit of a breaking detector.

Figure 4 is a schematic diagram of a circuit made of several breaking detectors.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 Referring to Figure 1, the shear pin breaking detector comprises a tube 2 in which a printed circuit 4 is inserted. The tube can be made in Plexiglas (Trademark), in Bakelite (Trademark) or any other plastic or other material capable of supporting the working conditions of the detector.

10 Referring to Figure 3, the printed circuit 4 comprises a conductive strip 6 e.g. made of copper on each side of a central insulating strip 8. The conductive strip 6 has upper ends forming connection terminals 10, 12 on each side of the insulating strip 8.

15 Referring again to Figure 1, the connection terminals 10, 12 are connected to respective cables 14, 16 provided with female and male connectors 18, 20 allowing series connection of the breaking detector with other similar detectors up to a power supply source 28 as illustrated in
20 Figure 4. An identification circuit made of resistor 22 in series with an electroluminescent diode 24 is connected between the two terminals 10, 12 of the printed circuit 4. The identification circuit is in parallel with the conductive strip 6 of the printed circuit 4. Thus, normally,
25 the current supplying the breaking detector passes through the conductive strip 6 of the printed circuit 4 and the electroluminescent diode 24 remains off. In the event of a breaking of the conductive strip 6 causing a circuit opening, the current then passes through the identification
30 circuit and the electroluminescent diode 24 lights up.

A resin or any other insulating material will preferably be injected in the tube 2 in order to consolidate and stabilize the printed circuit 4 and the tube 2 together.

To facilitate the assembly of the pieces, the tube 2 may be provided with a cap 26 which may be glued to the upper end of the tube 2, the cap having an opening at the top for the passage of the cables 14 and 16 and the
5 electroluminescent diode 24.

Referring to Figure 2, the breaking detector is insertable at the center of a shear pin 30. The shear pin 30 exhibits a weakness area 32 more prone to shearing efforts. The diameter at the bottom of the area 32 may be determined
10 as a function of the respective breaking loads of the shear pin types and tests with samples in laboratory.

Referring to Figure 4, all the breaking detectors 34 of a group are connected together and preferably to a warning pilot 36 of an alarm panel (not illustrated). When there is
15 a breakage of a shear pin, such as represented by the circuit opening 38, the light indicator of the concerned detector and the warning pilot 36 of the alarm panel light up. The location of the defective shear pin is then easy and quick.

20 While embodiments of this invention have been illustrated in the accompanying drawings and described above, it will be evident to those skilled in the art that changes and modifications may be made therein without departing from the essence of this invention. For example,
25 the printed circuit 4 can be replaced by a simple conductive wire (not illustrated) forming a loop along the length of the tube 2. In the case of a printed circuit, it will be possible to easily change its length by cutting it at the desired length and by soldering the sections then separated
30 of the conductive strip together at the cut end of the printed circuit. The tube may also be cut at the desired length. The diameter of the tube, its thickness and its material composition may be chosen or adapted as a function

of the dimensions of the shear pin and of the desired shear parameters. Any other appropriate type of warning pilot and of corresponding circuitry can be used instead of an electroluminescent diode. According to the use conditions of
5 the breaking detector, the tube may be replaced by simple spaced apart rings (not illustrated). Adaptation rings may also be added to a tube if the outer diameter of the tube is too small for the bore or hole of a shear pin.